Overview of the WESTCARB Geologic Pilot Tests

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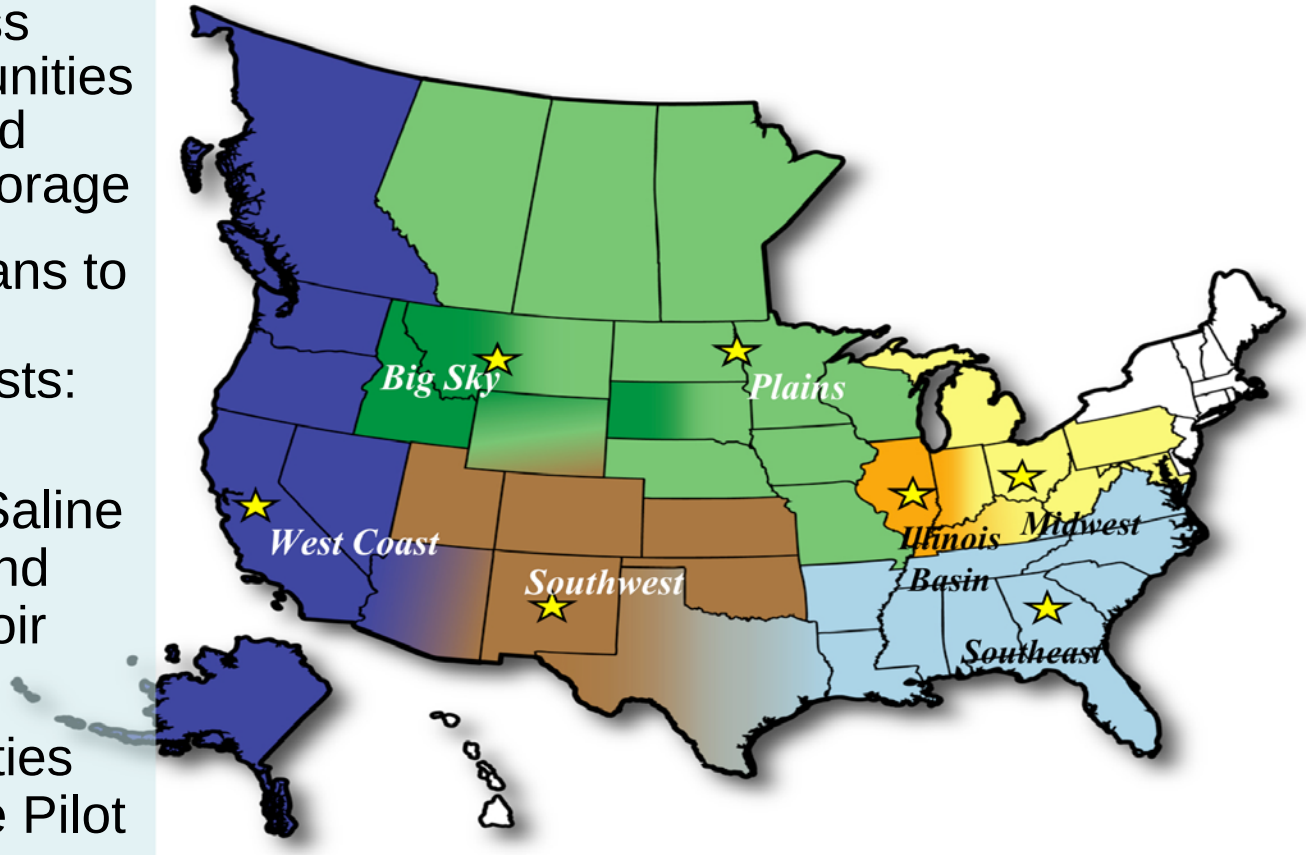
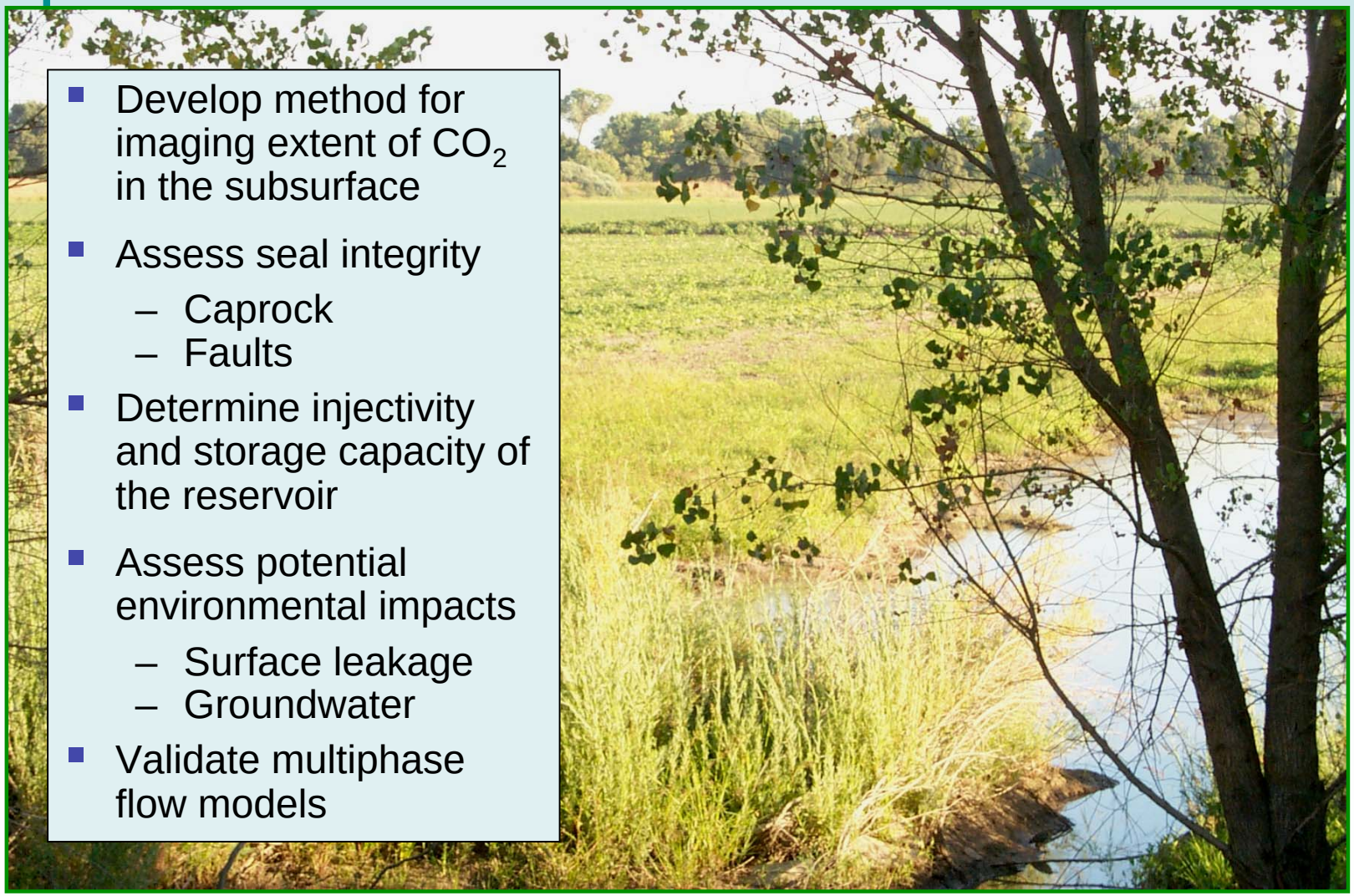
WESTCARB One of Seven DOE Regional Sequestration Partnerships

- Goal is to assess regional opportunities for terrestrial and geologic CO_2 storage
- WESTCARB plans to conduct three geologic pilot tests:
  - Rosetta Resources Saline Formation and Gas Reservoir Pilot Tests
  - Arizona Utilities CO_2 Storage Pilot Test



WESTCARB Pilot Test Objectives



- Develop method for imaging extent of CO_2 in the subsurface
- Assess seal integrity
  - Caprock
  - Faults
- Determine injectivity and storage capacity of the reservoir
- Assess potential environmental impacts
  - Surface leakage
  - Groundwater
- Validate multiphase flow models

WESTCARB Geologic Pilot Tests

Rosetta Resources CO_2 Storage Project

Rosetta Resources, Inc.

California Energy Commission

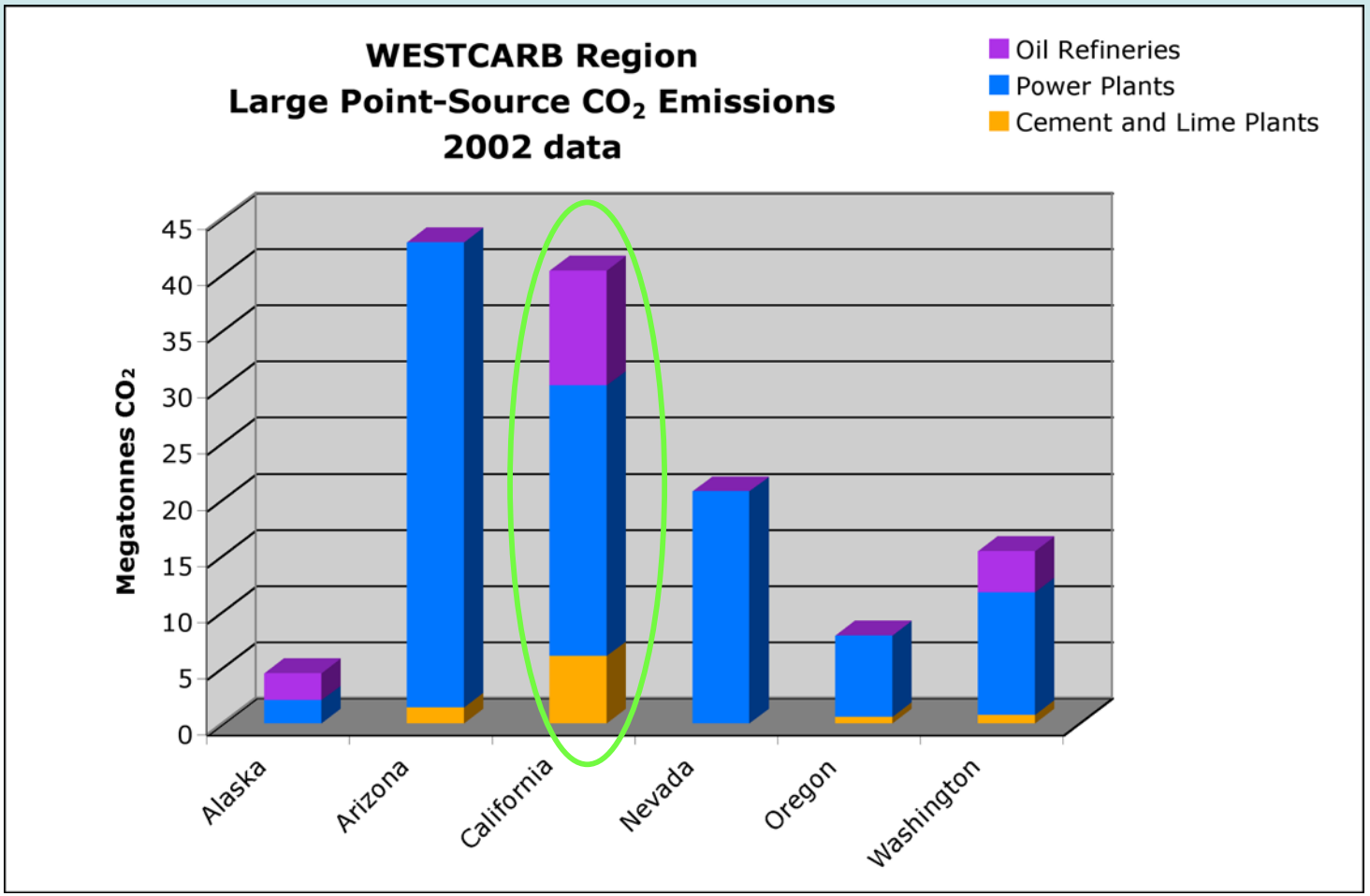
Lawrence Berkeley National Laboratory

US Department of Energy

Rosetta RESOURCES

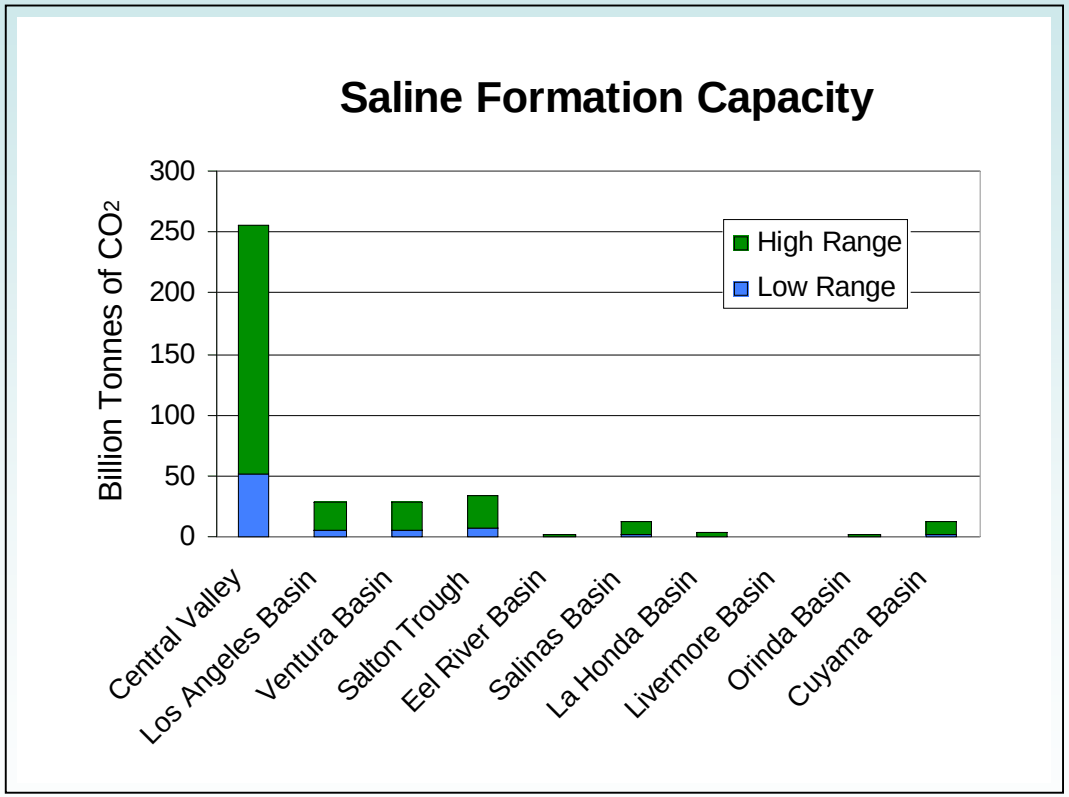
BERKELEY LAB

California Large Point-Source CO_2 Emissions



CO_2 Storage Capacity in California

- Oil Reservoirs
  - 3.8 billion tonnes
- Gas Reservoirs
  - 1.8 billion tonnes
- Saline Formations
  - 75 to 300 billion tonnes

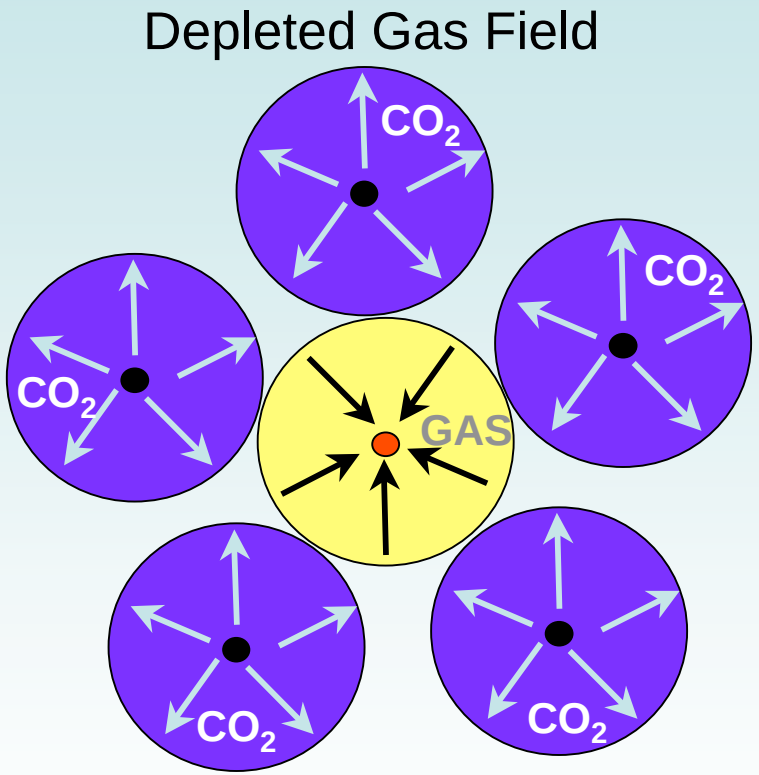


Rosetta Pilot Test Enhanced Gas Recovery Research

- CO_2 Storage Enhanced Gas Recovery (CSEGR)

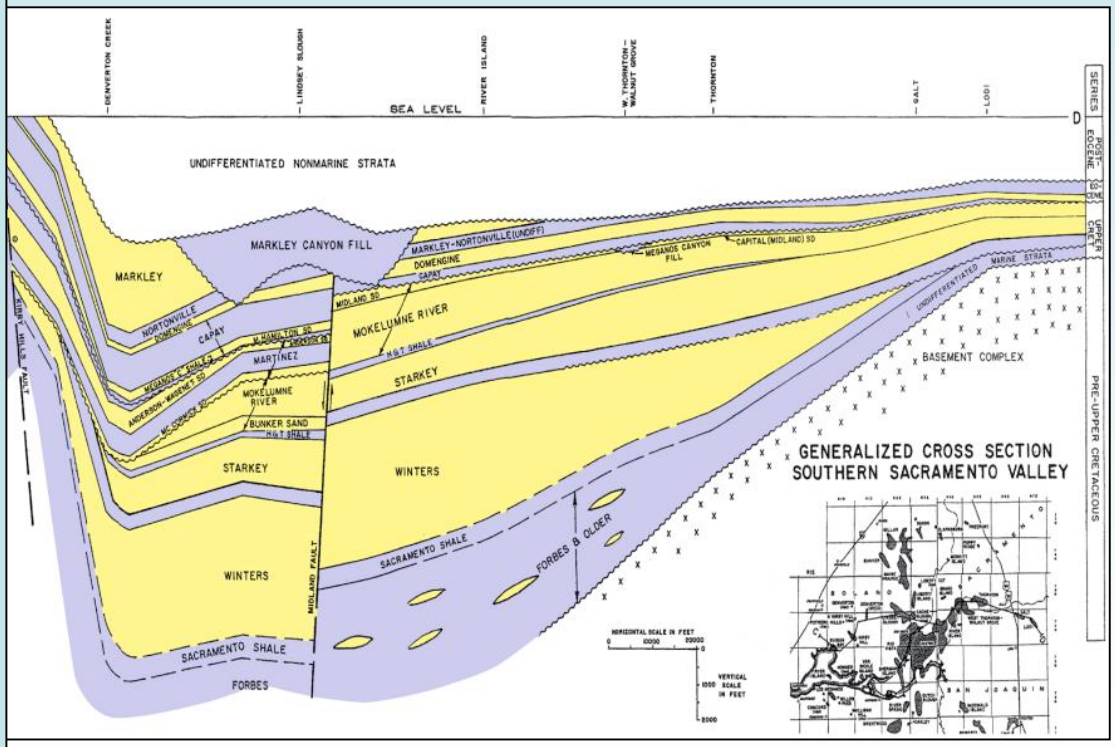
Primary Mechanisms

- Repressurize depleted natural gas reservoir using CO_2
- Use CO_2 to sweep natural gas toward producing wells



Sacramento Basin Province

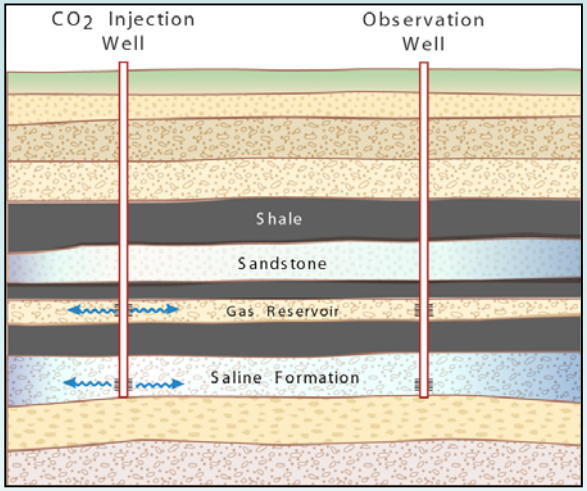
- Numerous depleted and active gas fields throughout province
- Located in the Central Valley near large point sources
- Numerous thick reservoirs capped by low permeability seals
- Seismic stability is relatively good

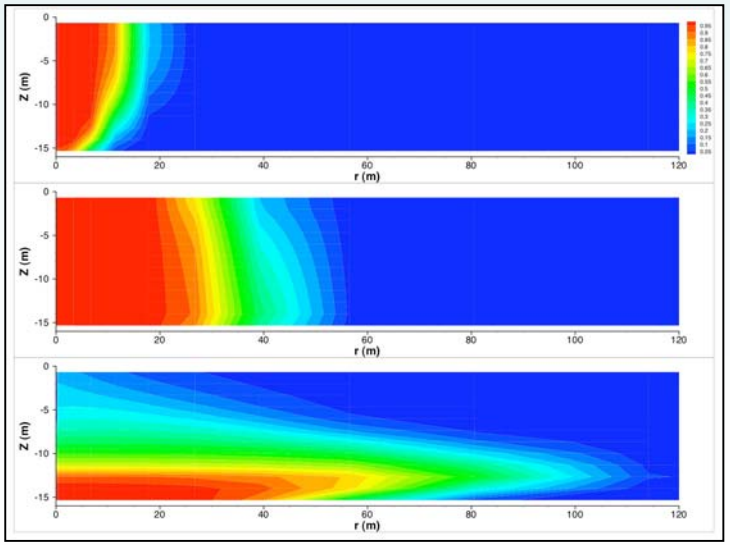


(modified from DOG, 1983)

What Are We Proposing to Do? (Rosetta Pilot)

- Drill two wells about 4000 ft deep penetrating a stacked reservoir
- Inject up to 2000 tonnes of CO_2 into a Saline Formation
- Seal off the Saline Formation
- Perforate gas reservoir and inject up to 2000 tonnes of CO_2 again
- Assess injectivity and storage capacity
- Model validation

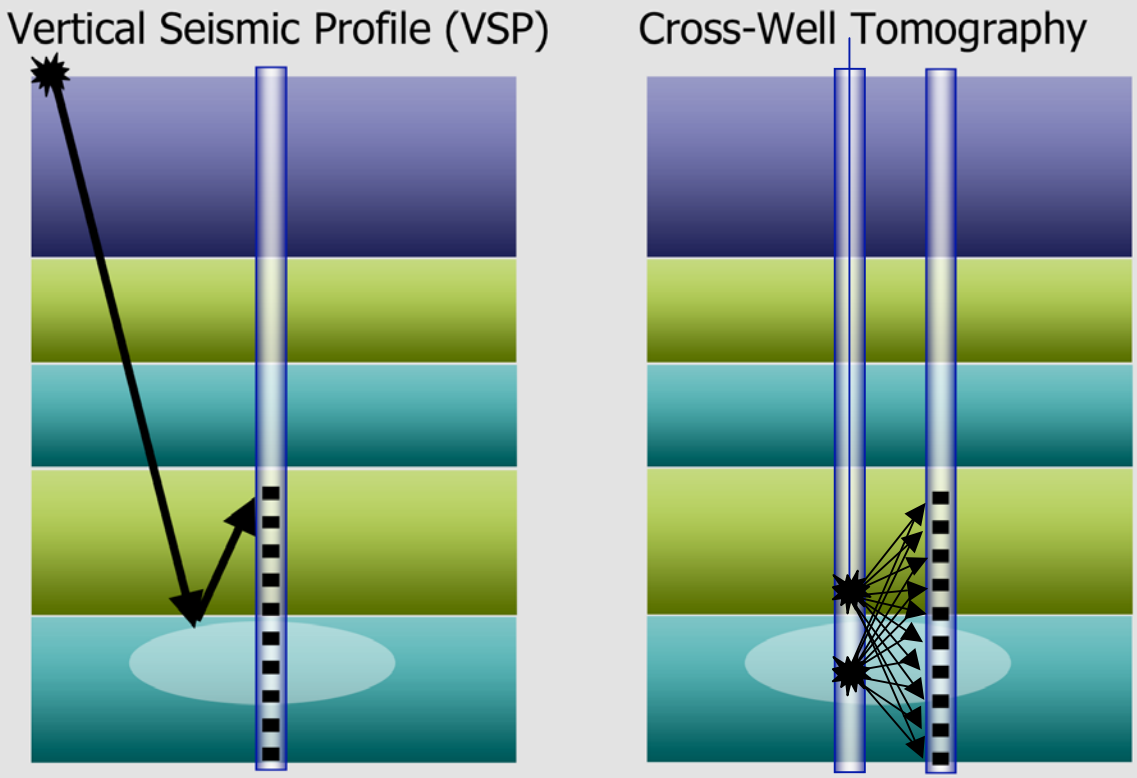




TOUGH2 Multiphase Flow Model

What Are We Proposing to Do? (continued)

- Image CO_2 in the subsurface using seismic techniques
  - Vertical seismic profiling (VSP)
  - Cross-well seismic
- Share results with the community
- Plug and abandon wells after completing the project



WESTCARB Geologic Pilot Tests

Arizona Utilities CO_2 Storage Pilot

Arizona Public Service Company

Electric Power Research Institute

Salt River Project

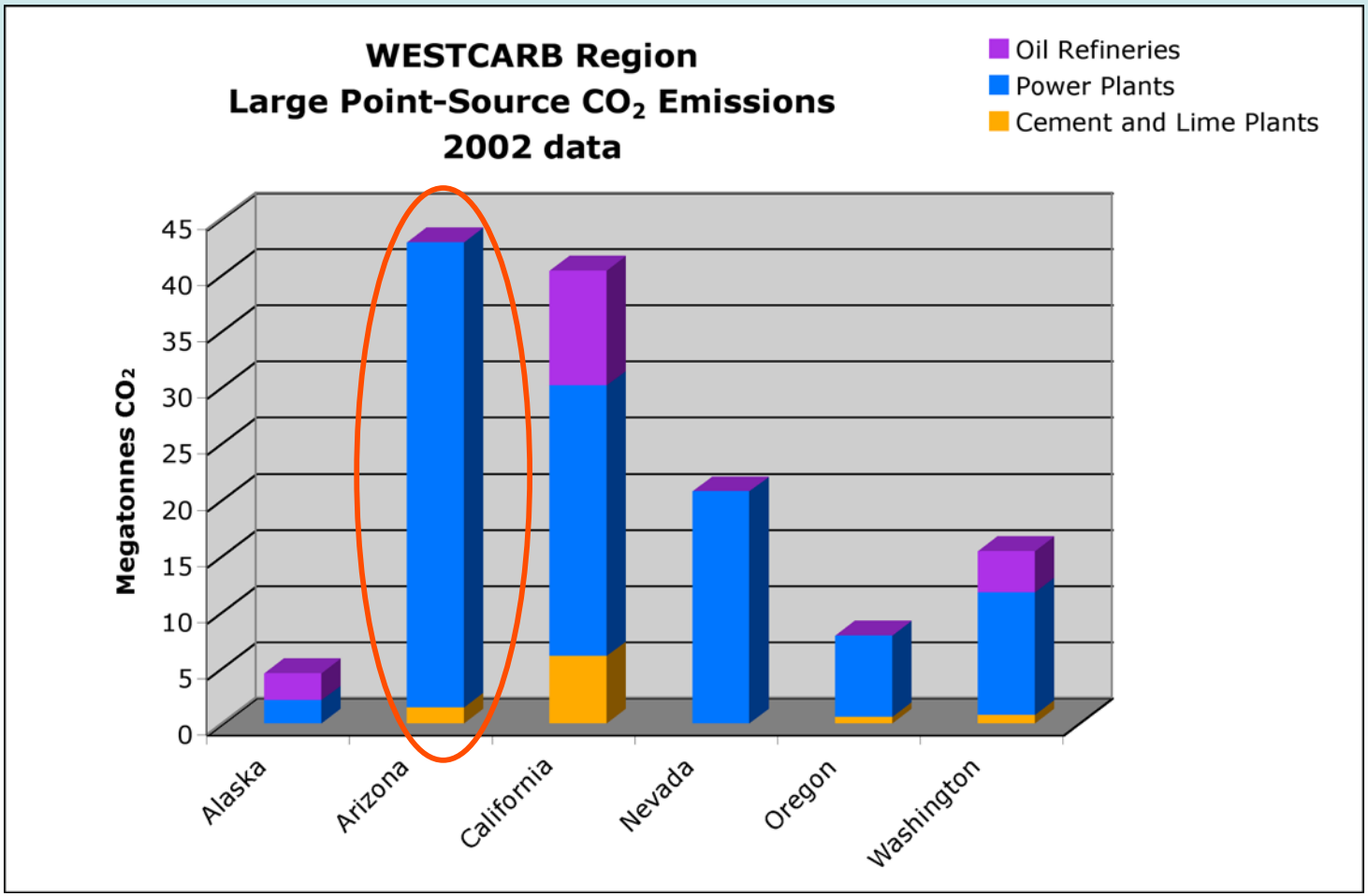
Tucson Electric Power

A UniSource Energy Company

ELECTRIC POWER RESEARCH INSTITUTE

BERKELEY LAB

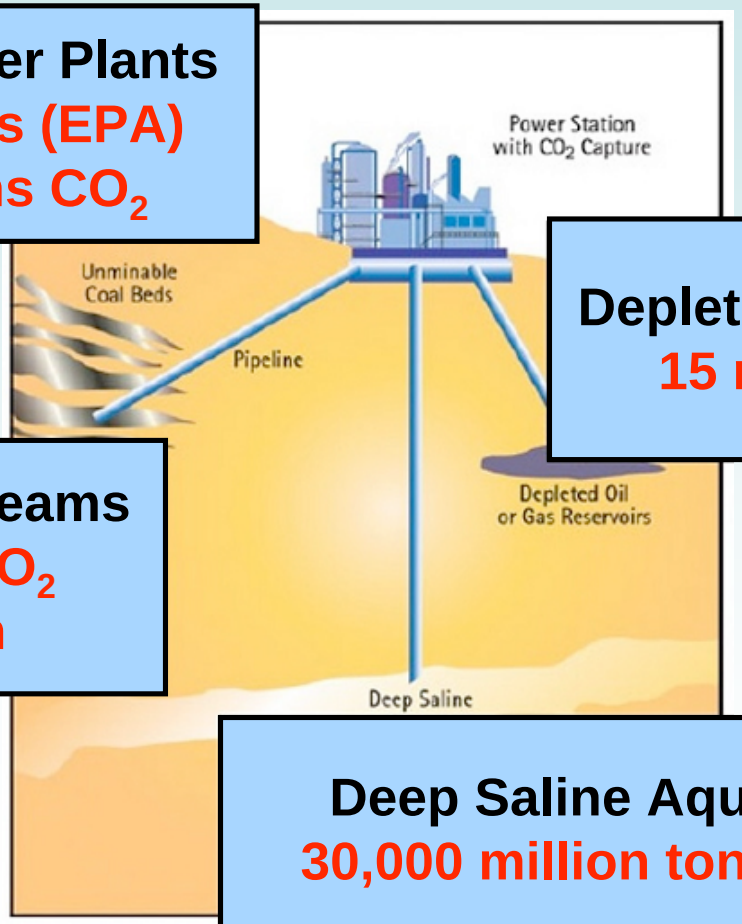
Arizona CO_2 Emissions Are Primarily From Coal-Fired Power Plants



Arizona Geologic Storage Potential

(Arizona Geological Survey)

All Arizona Power Plants
2002 Emissions (EPA)
45 million tons CO_2

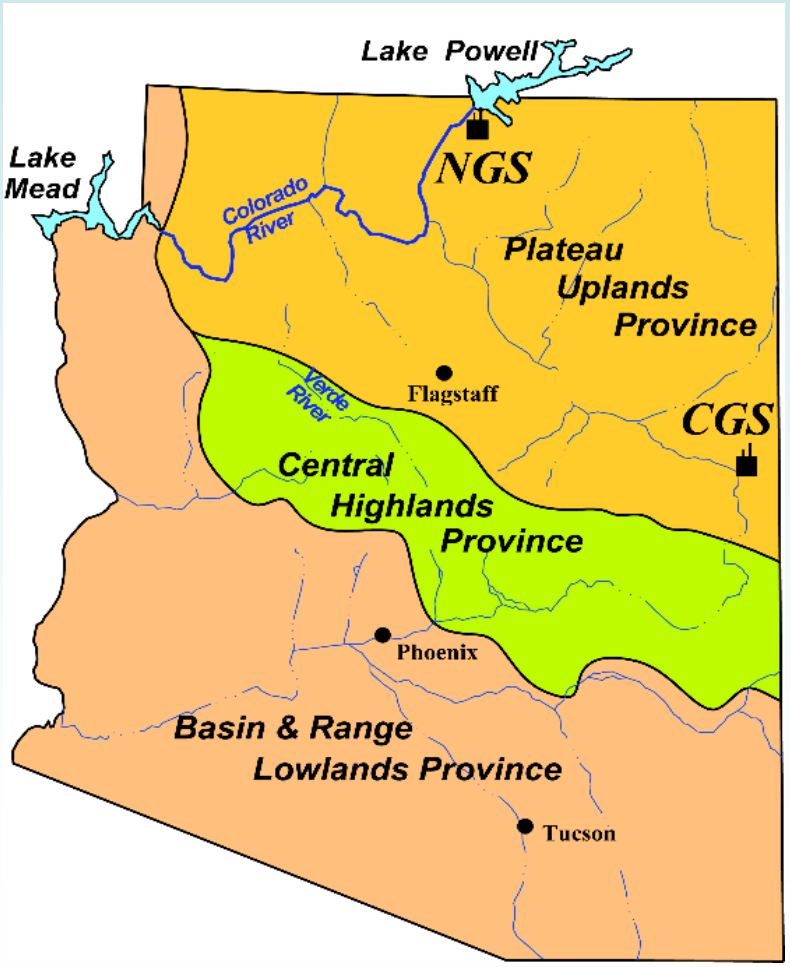


Depleted Oil & Gas Fields
15 million tons CO_2

Unmineable Coal Seams
Not a potential CO_2 storage option

Deep Saline Aquifers
30,000 million tons CO_2

Arizona Geologic Provinces



Basin and Range Province

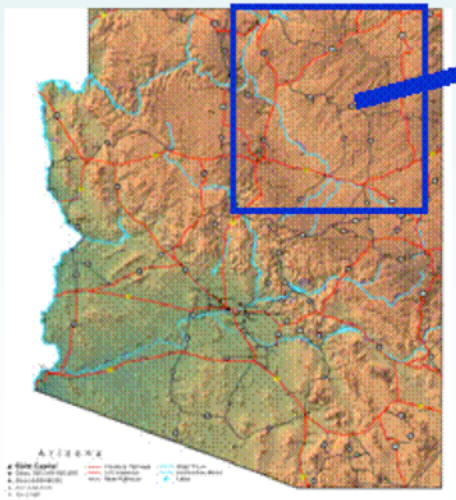
- Overall potential for geologic sequestration is likely to be poor

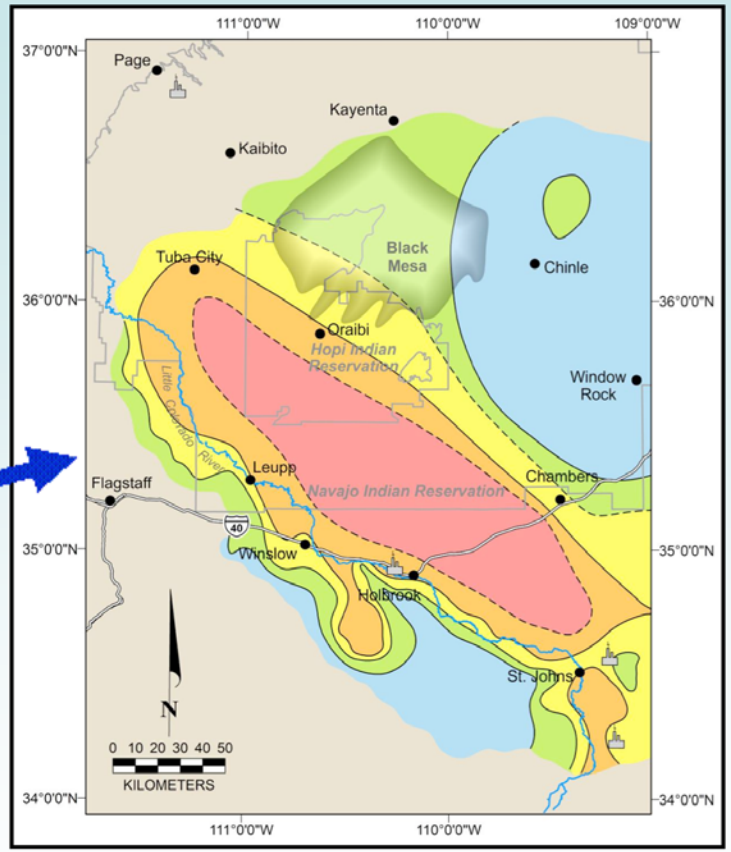
Colorado Plateau Province

- Thick sequence of laterally extensive, nearly flat-lying sedimentary strata
- Some structural deformation
- Some areas of coal, oil, and gas accumulations

Arizona Groundwater Resources

- Proposed project location near Cholla Power Plant overlies an area of nonpotable saline water



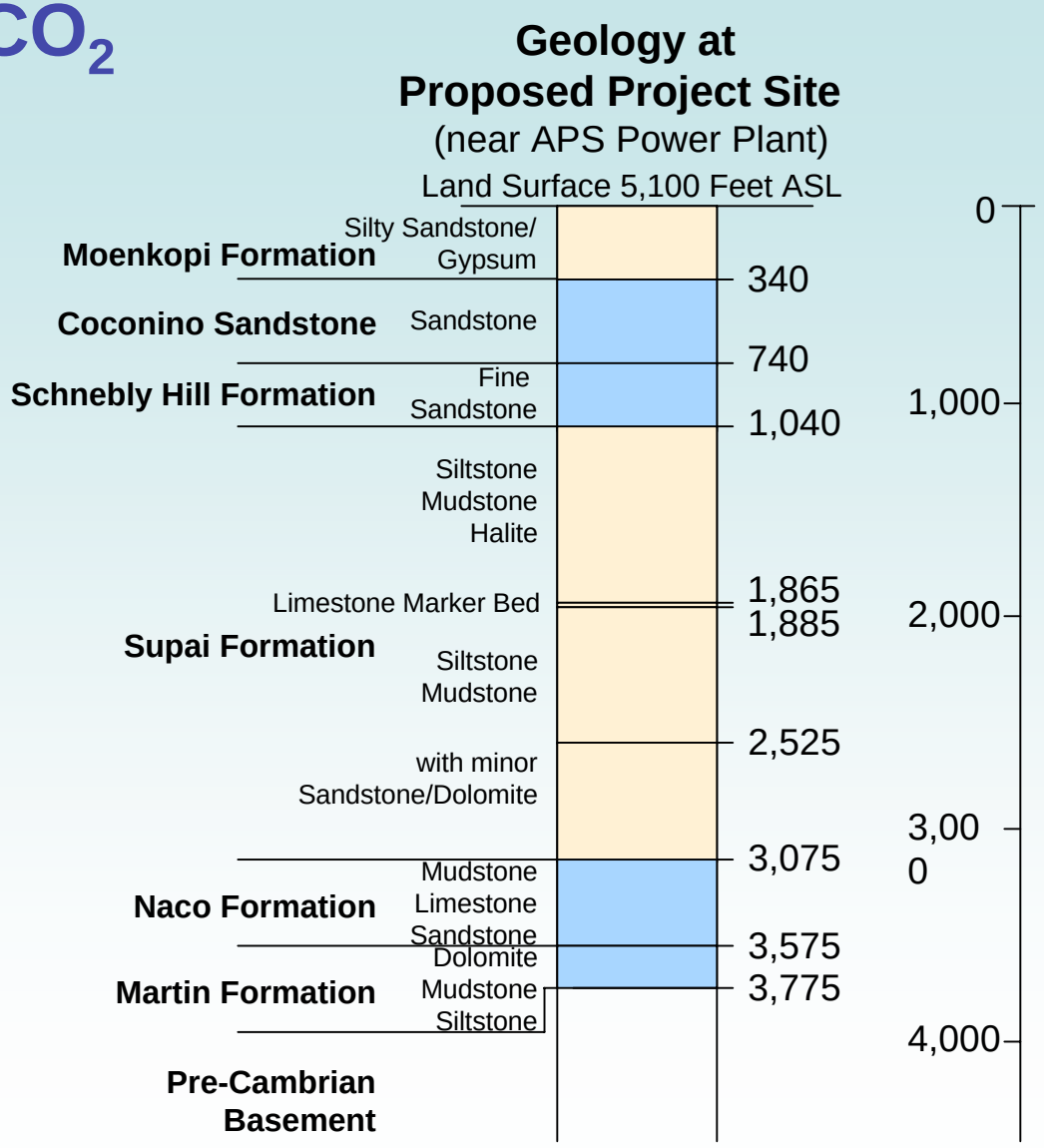


Distribution of dissolved solids in Coconino/DeChelly Sandstone

Source: Errol L. Montgomery & Associates

Arizona Utilities CO_2 Storage Pilot

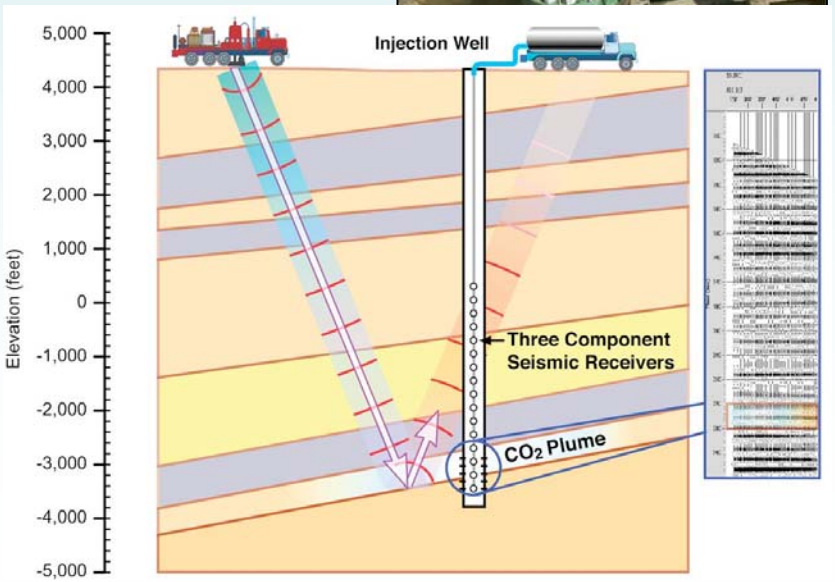
- Deep porous formations (Naco and Martin) minimize potential for leakage into shallower groundwater aquifers
- Injection test simulates a commercial operation where a single deep injection well may be the only well present



Source: Errol L. Montgomery & Associates

What Are We Proposing to Do? (Arizona Pilot)

- Drill a single well about 4000 ft deep near an ash storage pond about a mile north of APS's Cholla Power Plant
- Truck in commercial-grade CO_2 and inject it into the well
- Monitor the CO_2 movement in the subsurface using seismic techniques and check for surface leaks
- Exploratory nature given the lack of available data



What Are We Proposing to Do? (cont'd)

- Share our results with the community and public officials; compare our results with those from 25 similar tests across the United States and Canada
- Seal the well upon completion of the project in accordance with Arizona law
- Conduct outreach to educate and receive input from the public regarding climate change and geologic sequestration

Summary

The WESTCARB project is …

- Negotiating site access for the California Pilot
- Preparing permit applications for the Arizona Pilot
- Providing information to state and federal regulators
- Reaching out to the community through public meetings
- Developing site-specific models
- Ordering test equipment/services

…and will begin

- … testing in 2008